ABSTRACT

This dissertation deals with the subject of preparation of mixed bismuth layered perovskite-like (M-BLPO) materials, specifically $Bi_5Nb_3O_{15}$ materials obtained through solid-phase synthesis from a mixture of simple oxides by means of pressureless sintering under an air atmosphere. The test material was modified with titanium and tungsten ions.

The dissertation is divided into six main chapters. Chapter one provides an introduction to the subject matter of this dissertation. Chapter two presents the current state of knowledge in the field of the presented subject, as well as an overview of the applied research methodology and apparatus. This chapter also presents attempts to optimise the technological conditions for manufacturing such materials as described in the literature. Chapter three formulates the main thesis of the dissertation and defines the general and specific objectives of the dissertation, which amount to researching the interrelationship between technological conditions, chemical composition, crystalline structure, microstructure, as well as the dielectric and electrical properties of the materials studied.

Chapter four constitutes the experimental part of the dissertation. First, the technological process used to obtain the designed ceramic materials is presented. Subsequently, the author presents studies of the structural, microstructural and dielectric properties of the obtained $Bi_5Nb_3O_{15}$ base materials as well as materials with maximum dopant concentration $Bi_5TiNbWO_{15}$ produced under varying technological conditions. This stage was aimed at optimizing the technological process and selecting the best conditions for the manufacturing of compositions with fractional dopant concentration, namely $Bi_5Ti_{1/4}Nb_{5/2}W_{1/4}O_{15}$, $Bi_5Ti_{1/2}Nb_2W_{1/2}O_{15}$ and $Bi_5Ti_{3/4}Nb_{3/2}W_{3/4}O_{15}$ materials, which forms the main objective of the dissertation. The results of a comprehensive materials characterisation of the manufactured intermediate compositions were compared with the results of characterisation of the materials manufactured in the previous stage. The author determined the influence of the chemical composition on the structure, microstructure and dielectric properties of the ceramics in the temperature domain as well as its influence on the impedance characteristics in the frequency domain. An additional analysis of AC and DC conductivity were performed. The research results presented in this dissertation relate to issues of materials science, impedance spectroscopy, structural analysis and mathematical modelling. The conclusions based on the analyses carried out in the experimental part are presented in chapter five. Chapter six contains a bibliography of literature cited in this dissertation.